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TITLE

Device For Eliminating The Flickering Phenomenon Of TFT-LCD

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates in general to a thin-film-transistor liquid-crystal-display(TFT-LCD). In particular, the present invention relates to a flicker-proof thin-film-transistor liquid-crystal-display.

Description of the Related Art

The structure of a conventional TFT-LCD is comprised essentially of LCD cells comprising a pair of electrode substrates filled with liquid crystal molecules. Polarizors are adhered to the sides of the electrode substrates. Signal lines and scanning lines are formed perpendicularly with each other forming a matrix on one of the substrates. The scanning lines are connected to each gate of the TFT controlling the on/off state of the TFT and hence the writing of video signals.

Referring to Figs. 1A and 1B, a pulse signal at the front of the signal scanning line is shown in Fig.1A. Because of the parasitic resistors and capacitors on the scanning line, the input pulse signal is subjected to RC (time constant) delay. Therefore at the end of the scanning line, the pulse wave is transformed to that shown in Fig.1B. A voltage coupled from the gate of the TFT is defined as follows:

$$V_{COUPLED} = V_G \times C_{gs} / (C_{gs}+C_{LC}+C_{ST})$$

where V_G is the voltage applied to the gate, C_{gs} is the capacitance between the gate and the source, C_{LC} is the capacitance of the liquid crystals, and C_{ST} is the capacitance of a storage capacitor.

The voltage applied to the gate of the TFT at the front end of the scanning line is V_{G1}, and the voltage applied to the gate of the TFT at the rear end of the scanning line is V_{G2}. In the conventional art, because V_{G1} is greater than V_{G2}, the coupled voltage $V_{COUPLED1}$ is greater than $V_{COUPLED2}$. As a result, the LCD display may flicker.

In order to solve the problem of flickering, Japanese Patent Application Laid-Open No 11-281957 (Sharp Corporation) reduces the gate voltage. That is, the circuit in Fig.2 is adopted to provide the V_{VH} in Fig.3 for the driving circuit of the gate of the TFT and the pulse wave generated is as shown in Figs.4A and 4B. Referring to Fig.3, S_{tc} is a trigger voltage for controlling switches SW1 and SW2 such that the circuit is discharged when SW1 is off and SW2 is on resulting in drop of V_{GH}; and the circuit is connected to the power supply V_{dd} and recharged when SW1 is on and SW2 is off to allow V_{GH} to climb back. Additionally, Fig.3 shows curve A representing the voltage signal V_{GH} at a lower temperature and curve B representing the voltage signal V_{VH} at a higher temperature.

In Figs.4A and 4B, the front end of the gate pulse input to the scanning line is slashed so that the gate voltage V_{G1} of the input pulse is approximately equal to the gate voltage V_2 of the pulse transmitted to the end of the scanning line. Hence the coupled voltage $V_{COUPLED1}$ is approximately equal to $V_{COUPLED2}$ to avoid the flicker phenomenon.

Transistor is usually used as a switch as shown in the circuit in Fig.2. Normally, TFT needs a longer period to be recharged when the temperatures is low dues the inferior mobility of the carriers. Nonetheless, the temperature characteristic of Transistor slashes the gate pulse more at lower temperatures. The slashes on the gate pulses reduce the recharging time of the TFT. Consequently, insufficient recharging time of TFT occurs at lower temperatures.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a device minimizing the flickering phenomenon of a thin-film-transistor liquid-crystal-display (TFT-LCD), and avoiding the recharge problem when the TFT operates under low temperature.

To achieve the object of the present invention, a flicker-proof device for a TFT-LCD provided using temperature compensating components or circuits to achieve a V_{GH} curve corresponding to the temperature characteristics of the TFT. In other words, the gate pulse is slashed more substantially at high temperature and less at low temperature so that the recharging problem at low temperature is solved.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention can be more fully understood by reading the subsequent detailed description in conjunction with the examples and references made to the accompanying drawings, wherein:

Fig. 1 shows a pulse signal at the front of the signal scanning line;

Fig. 2 shows a pulse signal at the end of the signal scanning line;

Fig. 3 shows the I/O signal waveform of the circuit in Fig.2;

Figs. 4A and 4B show the pulse wave provided to the gate of the TFT on the scanning electrode by the circuit in Fig.2;

Fig. 5 shows the circuit of the device used in the embodiment of the present invention to eliminate the flickering of the TFT-LCD;

Fig. 6 is the I/O waveform generated by the circuit in Fig. 5; and

Fig. 7 shows the pulse signal provided to the gate of the TFT of the scanning line according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Fig.5, the device of the present invention for eliminating the flicker phenomenon of a thin-film-transistor liquid-crystal-display (TFT-LCD) comprises: a first switch SW1 10, a discharge circuit 12, a second switch SW2 14, a trigger signal source 16, and a plurality of compensators 18. The first switch SW1 10 is configured between a power supply and the output end of the device. The discharge circuit 12 is connected between the first witch SW1 10 and the output end of the device at one end and is connected to the other ground at the other end. The second switch SW2 14 is used for controlling whether the discharge circuit is grounded. The trigger signal source 16 is used for controlling the switches SW1 and SW2. When the first switch SW1 10 is on and the second switch SW2 14 is off, the output end of the device is connected to the power supply V_{dd} and the circuit is recharged. When the first switch SW1 10 is off and

the second switch SW2 14 is on, the discharge circuit 12 is grounded and discharged. The temperature compensators 18 can be located between the trigger signal source 16 and the first switch SW1 10, the trigger signal source 16 and the second switch SW2 14, or anywhere in the discharge circuit 12 to equalize the voltage float at the output end of the device to the temperature characteristic of the TFT such that the circuit recharge or discharge rate is slower at lower temperatures and faster at higher temperatures.

Fig.6 shows the voltage signal V_{GH} generated by the power supply described above. Curve A' represents the pulse wave of V_{GH} at a higher temperature, curve B' shows the pulse wave of V_{GH} at a lower temperature.

The voltage signal V_{GH} is sent to the driver of the gate of the TFT and output as the gate pulse shown in Fig.7. As shown in the Fig.7, curve A" is the gate pulse at a lower temperature. Being slashed less, it provides a longer recharging period for the TFT. Curve B" is the gate pulse at a higher temperature. It is slashed more substantially to provide a shorter recharging period for the TFT.

The first and the second switches 10 and 14 can be transistors and are controlled by the trigger signal 16. The discharge circuit 12 comprises a resistor R and a capacitor C connected in parallel, wherein the resistor R is grounded via the second switch SW2.

The temperature compensator 18 can be a component, such as a transistor with certain temperature characteristics or a thermistor, or a temperature-compensation circuit such as a diode circuit. The temperature compensator of the present invention has a negative temperature constant. Taking the

thermistor for example, the resistance becomes smaller when the temperature becomes larger. Conversely, the resistance becomes larger when the temperature decreases. When the temperature becomes lower and the resistance increases, the RC constant in the discharge circuit 12 increases. As a result, the discharge rate becomes slower, and the pulse wave provided to the TFT is slashed less, leaving a longer recharging period for the TFT. In other words, the image signals on the signal lines have more time to be written into the liquid crystal capacitors and the storage capacitors at the lower temperature.

Accordingly, the present invention uses devices with temperature-compensation characteristics to make the gate pulse wave suffer less from the slash impact at low temperature and more at high temperature. Thereby, the length of the TFT conductive time to meet the recharging requirements at different temperatures can be controlled. The temperature-compensation device can be components or circuits with negative temperature constant.

While the present invention has been particularly shown and described with reference to a preferred embodiment, it will be readily appreciated by those of ordinary skill in the art that various changes and modifications may be made without departing from the spirit and scope of the invention. It is intended that the claims be interpreted to cover the disclosed embodiment, those alternatives which have been discussed above and all equivalents thereto.